B.E. DEGREE END SEMESTER EXAMINATIONS, NOV/DEC 2012

ELECTRONICS AND COMMUNICATION ENGINEERING

SEVENTH SEMESTER – (REGULATIONS 2008)

EC 9037 ADVANCED DIGITAL SIGNAL PROCESSING

Time: 3 hrs Max. Marks: 100

Answer ALL Questions

Part– A (10 x 2 = 20 Marks)

1. Show that a random phase sinusoid is a WSS process.

2. What is a MA process?

3. Define bias and consistency of an estimate?

4. Find $P_x(e^{j\omega})$ of $x(n)=A\sin(n\omega+\phi)+v(n)$ where ϕ is a r.v. uniformly distributed in the interval $[-\pi,\pi]$ and v(n) is white noise with variance σ_v^2.

5. What is orthogonality principle in Wiener filtering?

6. Write the Wiener-Hopf equations for non-causal and causal IIR Wiener filters.

7. Determine the range for the step size (μ) in LMS algorithm by considering the eigen values of 2 x 2 autocorrelaion matrix, $R_x = [\,4 \;\; 1\; ; 1 \;\; 4\,]$.

8. What is meant by convergence and stability in adaptive filters.

9. What is MRA equation?

10. Write the equations for computing approximate and detail coefficients in 1-D DWT.

Part– B (5 x 16 = 80 Marks)

11. (a) Derive the necessary expressions for Fast Wavelet transform and draw the scheme for obtaining approximation and detail coefficients from j+1 resolution to resolution j. (8)

(PTO)

(b) Compute the approximation and detail coefficients for f(0)=1, f(1)=2, f(2)=3, f(3)=4 given $h_\phi(n)=\begin{cases}1/\sqrt{2} & for \quad n=0,1\\ 0 & otherwise\end{cases}$ and

$$h_\psi(n)=\begin{cases}1/\sqrt{2} & for \quad n=0\\ -1/\sqrt{2} & for \quad n=1\\ 0 & otherwise\end{cases}$$ (8)

12(a). (i) Find the autocorrelation sequence corresponding to

$$P_X(z)=\frac{1}{5+3\cos\omega}$$ (8)

(ii) Show that $r_x(0) \geq |r_x(k)|$ for a WSS process. (8)

OR

12(b). Derive Yule-Walker equations for ARMA process.

13(a). Discuss Welch method of power spectrum estimation, its bias and variance for different cases of overlapping of data.

OR

13(b). Derive a 3rd order all-pole model for the signal having $r_x(0) = 1$, $r_x(1) = 0.8$, $r_x(2) = 0.5$, $r_x(3) = 0.1$ using Levinson recursion.

14(a). Design a Wiener filter with filter coefficients w(0), w(1) and w(2) for estimating d(n) from x(n)=d(n)+v(n) where d(n) is an AR(1) process generated as d(n) = 0.5 d(n-1)+w(n) where $\sigma_w^2 = 1$ and $\sigma_v^2 = 1$.

OR

14(b). Design a causal wiener filter H(z) and its impulse response for estimating d(n) in x(n)=d(n)+v(n) where d(n) is an AR(1) process generated as d(n) = 0.6 d(n-1)+w(n) where $r_w(k) = 0.8\delta(k)$ and $r_v(k) = \delta(k)$.

15(a). Derive the range for the step size (μ) in LMS algorithm.

OR

15(b). (i) Derive the weight update equation in NLMS algorithm and explain the advantages and disadvantages of NLMS as compared with LMS algorithm. (10)

(ii) Discuss the computational requirements in LMS algorithm. (6)

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